



Missouri Department of Natural Resources

Total Maximum Daily Load Information Sheet

Big River and Flat River Creek

Waterbody Segment at a Glance:

County: St. Francois/Jefferson
Nearby Cities: Leadwood to Eureka
Length of impairment: Big River - 93 miles
Flat River Creek – 5 miles
Pollutants: Lead, Nonvolatile Suspended Solids (NVSS)
Source: Old Lead Belt Abandoned Mine Land

Other Pollutant: Zinc (Flat River Creek only)
Source: Elvins tailings pile



State map showing location of watershed

TMDL Priority Ranking: High

Description of the Problem

Beneficial uses of Big River and Flat River Creek:

- Livestock and Wildlife Watering
- Protection of Warm Water Aquatic Life
- Protection of Human Health associated with Fish Consumption

Use that is impaired

- Protection of Warm Water Aquatic Life

Standards that apply

- Missouri Water Quality Standards for metals found in 10 CSR 20-7.031(4)(B)1 state:
Water contaminants shall not cause the criteria in Tables A and B to be exceeded.
Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded.
- The numeric standards for lead and zinc are dependent on the hardness of the water. The lead standard that applies in these waterbodies is 23 micrograms per liter ($\mu\text{g/L}$) at a hardness of over 200. At the same hardness, the zinc standard is 433 $\mu\text{g/L}$. These are listed in Table A of the WQS.
- Standards for nonvolatile suspended solids (NVSS) can be found in the general criteria section of the WQS, 10 CSR 20-7.031(3)(A) and (C) where it states:

- Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses.
- Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses.

Background Information and Water Quality Data

Flat River Creek is a tributary to Big River. It is impaired by three sources:

- Erosion of lead tailings from the Federal tailings pond (St. Joe State Park),
- Erosion of lead tailings from the National Chat pile which adjoins the Flat River Glass company
- Erosion of tailings and discharge of dissolved zinc from the Elvins chat pile

Erosion of tailings directly from the Leadwood and Desloge tailings piles and tailings entering from Flat River Creek impair Big River. Tailings are the part of washed or milled mineral ore considered too poor to be treated further. In other words, the ground-up rock left over after extracting the desired minerals (in this case lead and zinc). Erosion has resulted in a large amount of these tailings being deposited in pools within these streams. These tailings are predominantly sand-sized pieces of limestone formed during the ore separation process. These sediments (or nonvolatile suspended solids) reduce the aquatic habitat quality by smothering natural substrates (materials in the streambed). Aquatic invertebrate animals (water insects, mussels and crayfish) and fish eggs are also smothered.

Fish and other aquatic life have accumulated elevated levels of lead in their bodies due to dissolved lead draining from the old tailings. Ninety-three miles of Big River, from Leadwood to the river's mouth, and the lower six miles of Flat River Creek presently are under a Missouri Department of Health and Senior Services (DHSS) advisory recommending no consumption of sunfish, carp or suckers due to lead contamination of these fish.

In humans, lead primarily affects the nervous system, blood cells, and processes for the metabolism of Vitamin D and calcium. Lead can affect the developing fetus during pregnancy and cause lower intelligence scores, poor attention levels; hearing, speech and language problems; reading disabilities; reduced motor skills and poor hand-eye coordination. Evidence suggests that lead toxicity may occur at levels as low as 10-15 micrograms per deciliter ($\mu\text{g/dL}$) of blood. According to the DHSS, 11 percent of the children in St. Francois County tested for blood lead levels actually have lead poisoning. It is not known how much of the lead contamination in humans in this area is due to consumption of fish as opposed to other possible sources of lead such as eating locally grown vegetables, inhalation of airborne lead or ingestion of lead in paint or in the soil.

Average levels of heavy metals upstream and downstream of the tailings areas are shown in the Table below for Flat River Creek and Big River, as are the Probable Effect Levels for these metals in sediments. These probable effect levels are the concentrations of metal in sediment that are likely to cause impairment to the aquatic biological community. These data show that levels of metals in stream sediments are higher downstream of the mining area than upstream and that sediment toxicity due to heavy metals may be occurring throughout the area.

Contamination of stream sediments has led to the contamination of fish and other aquatic life. Table 2 below shows average levels of lead in fish in Big River. There is no state or national

standard for allowable lead in food, but the World Health Organization (WHO) uses a standard of 0.3 mg/Kg. This level is exceeded in some kinds of fish in Big River downstream of the tailings area.

In the tables below, the entries in **bold** type exceed water quality standards.

Table 1

Mean Levels of Heavy Metals in the Sediments of Flat River Creek and Big River upstream and downstream of the Old Lead Belt Tailings Area (mg/Kg) and Number of Samples Comprising the Average (#)					
Location	Cadmium	Copper	Lead	Nickel	Zinc
Flat River Creek at Derby (upstream)	1.97 (4)	32 (5)	545 (7)	29.5 (2)	165 (7)
Flat River Creek below National Chat pile (downstream)	12.5 (7)	231 (6)	4,084 (7)	68.5 (2)	1,078 (7)
Big River at Irondale (upstream)	0.58 (10)	27.4 (5)	286 (10)	22.5 (2)	69.6 (10)
Big River below Desloge tailings pile (downstream)	86.6 (5)	31.2 (3)	3,311 (5)	(0)	4,104 (5)
Probable Effect Level of Metal in Sediment	3.2	100	82	33	540

Source: U.S. Geological Survey, University of Missouri Rolla, Department of Natural Resources, and Newfields Inc.

Table 2

Mean Concentrations of Lead in Fillets of Fish from Three Locations on Big River (mg/Kg) and Number of Samples Comprising the Mean (#)				
Location	Carp	Suckers	Bass	Sunfish
Big River at Irondale (upstream of tailings area)		0.041 (21)	0.036 (17)	0.019 (13)
Big River near Desloge (25 miles downstream of tailings area)	0.127 (3)	0.349 (12)	0.163 (3)	0.543 (10)
Big River at House Springs (55 miles downstream of tailings)		0.142 (22)	0.088 (14)	0.134 (10)

Source: University of Missouri Rolla, Missouri Department of Conservation, Department of Natural Resources and U.S. Environmental Protection Agency

In addition to heavy metals contamination of sediment and fish, water draining from the Elvins chat pile in Elvins has caused high levels of dissolved zinc in Flat River Creek. During low flow periods, there is enough zinc in the drainage from the chat pile to cause levels of zinc in Flat River

Creek to exceed state water quality standards for toxicity to aquatic life. Because compounds of zinc are generally soluble in neutral and acidic solution, zinc is readily transported in most natural waters and is one of the most mobile of the heavy metals. Hardness, dissolved oxygen, temperature and synergistic effects (more than the sum of the individual components) with other compounds all affect the toxicity of zinc to aquatic life¹. Zinc is an essential nutrient to aquatic and terrestrial organisms, but in excess can be highly toxic and has the tendency to bioaccumulate (build up in organisms) in the environment. A number of behavioral and physiological effects have been reported when test organisms have been exposed to increased zinc levels. Behavioral responses in fish include avoidance and changes in feeding rate and movement patterns. Physiological changes in fish include increased ventilation rates, frequency of coughing and a decrease in oxygen utilization.²

Table 3

Mean Concentrations of Dissolved Zinc in Flat River Creek and Number of Samples Comprising the Mean (#)			
Location	Dissolved Zinc (µg/L)	Hardness (mg/L)	Dissolved Zinc Water Quality Standard (µg/L)
Flat River Creek at Derby, upstream of tailings area	28.7 (19)	199 (13)	340
Flat River Creek at Main Street in Flat River	468.8 (32)	441 (22)	433

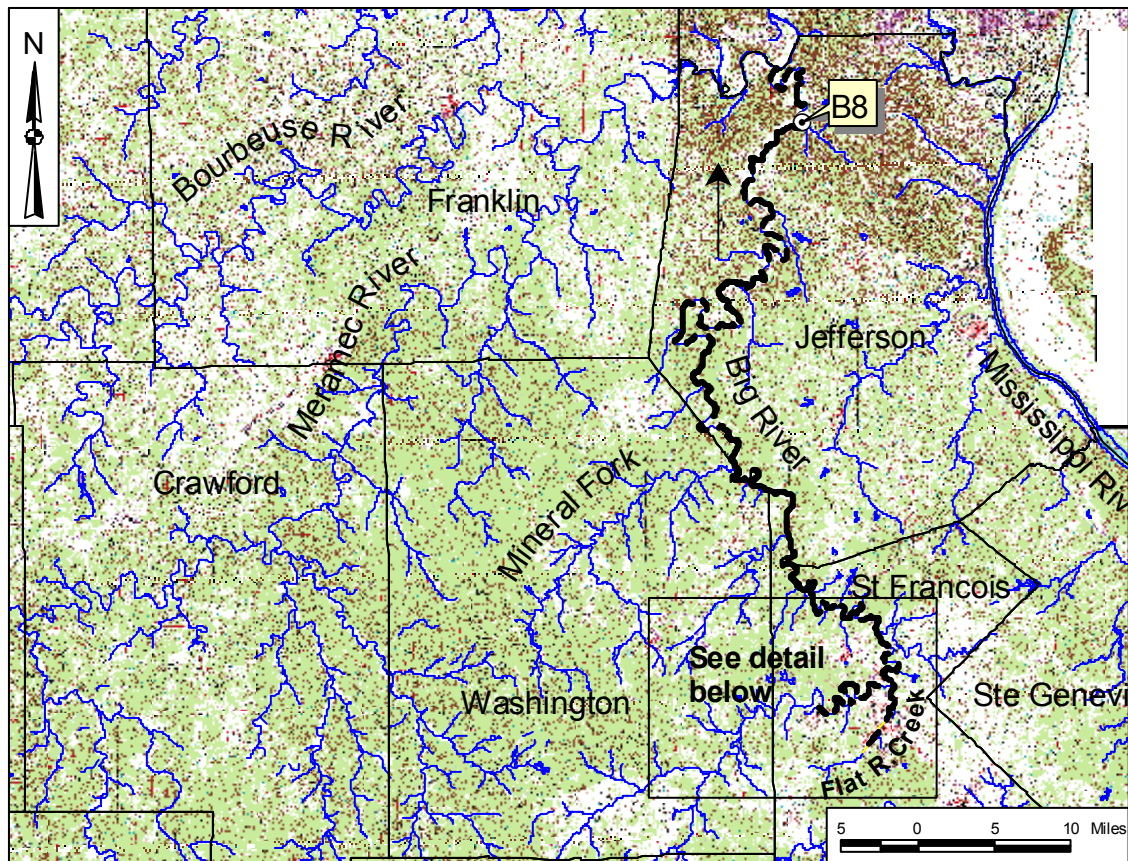
Studies on Flat River Creek and Big River in 2001-2003 by the department found a higher percentage of sand-sized or finer sediments deposited in the streambed within and a reduced diversity of aquatic macroinvertebrates within and downstream of the tailings area. Fine sediment deposition rates on the portion of Big River upstream of the tailings area averaged 12 percent and within and downstream of the tailings areas 26-64 percent. On Flat River Creek the portion upstream of the tailings area, stream substrate averaged 18-23 percent fine sediments and within and downstream of the tailings area 37-77 percent.

Maps and data on the following pages. For related information, see the [Shaw Branch Information Sheet](#). Shaw Branch is a tributary to Flat River Creek.

¹ Upper Sacramento River TMDL for Metals. California Environmental Protection Agency, 9/25/01.
www.waterboards.ca.gov/centralvalley/programs/tmdl/TMDL%20Final%20Report_2002Apr.pdf

² Red Clay Creek TMDL, Delaware Natural Resources and Environmental Control, 8/1/99.
www.dnrec.state.de.us/dnrec2000/library/water/rcproreg.pdf

Impaired Segments of Flat River Creek and Big River in St. Francois and Jefferson Counties, Missouri, and Sampling Site

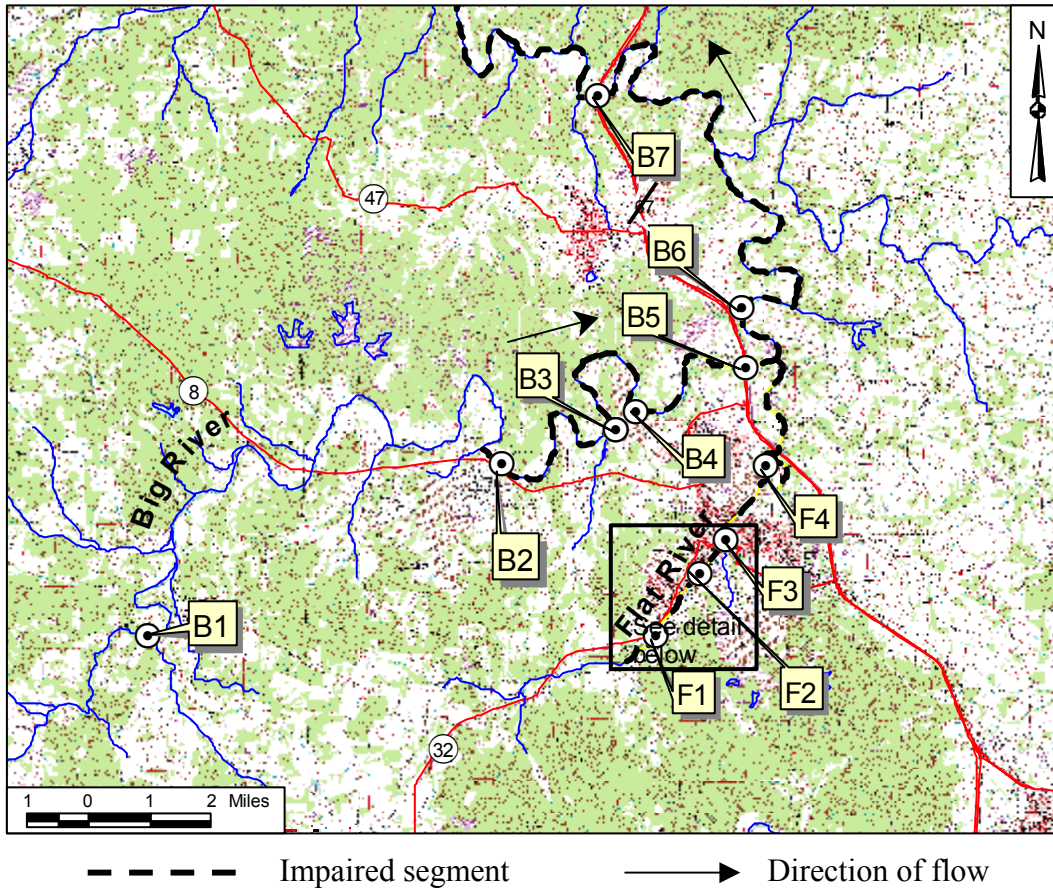


— — — — . Impaired segment

—————> Direction of flow

Sample Site
B8 – Big River at House Springs Access

Detail of Sampling Sites for Big River and Flat River Creek

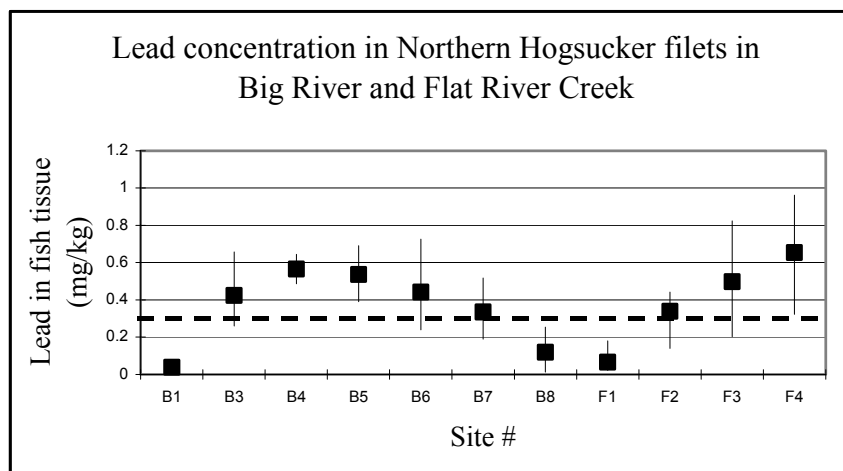
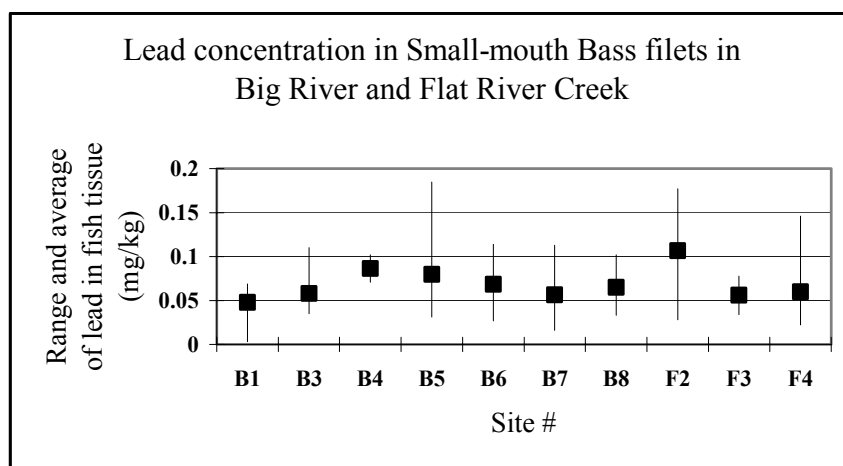
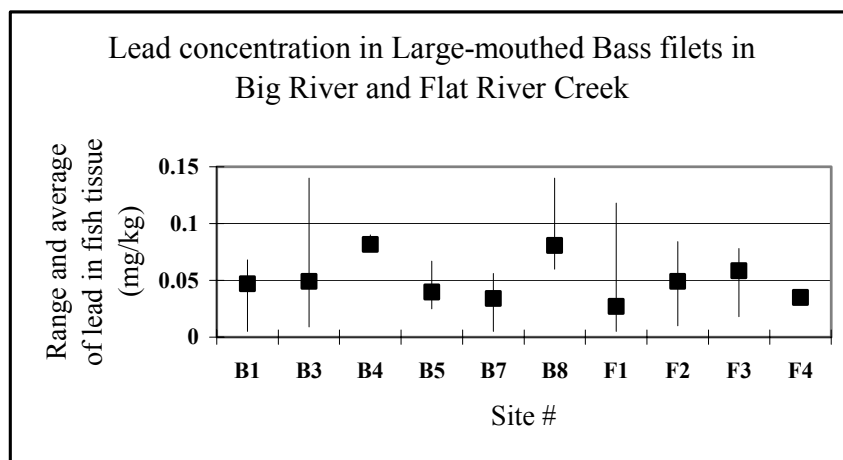


Sample Site Index

- B1 – Big River at Irondale
- B2 – Big River at Leadwood access
- B3 – Big River at Bone Hole
- B4 – Big River at East end of Desloge tailing pile
- B5 – Big River below Desloge
- B6 – Big River 1.2 miles below Flat River Creek
- B7 – Big River 11.7 miles below Flat River Creek

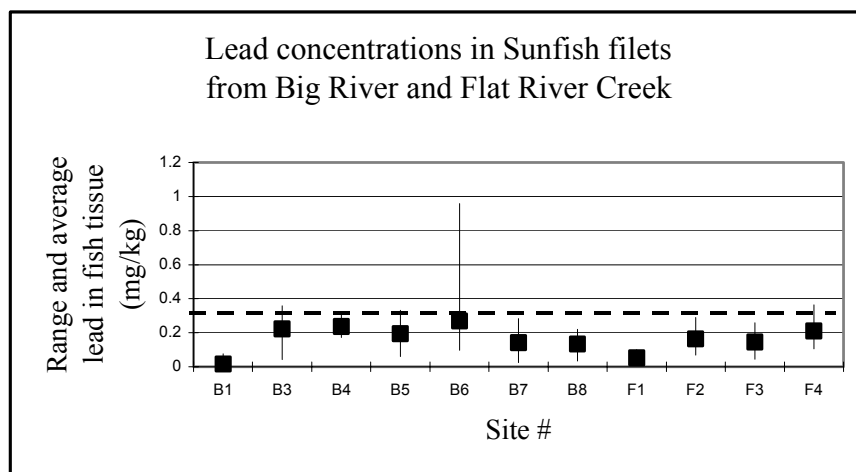
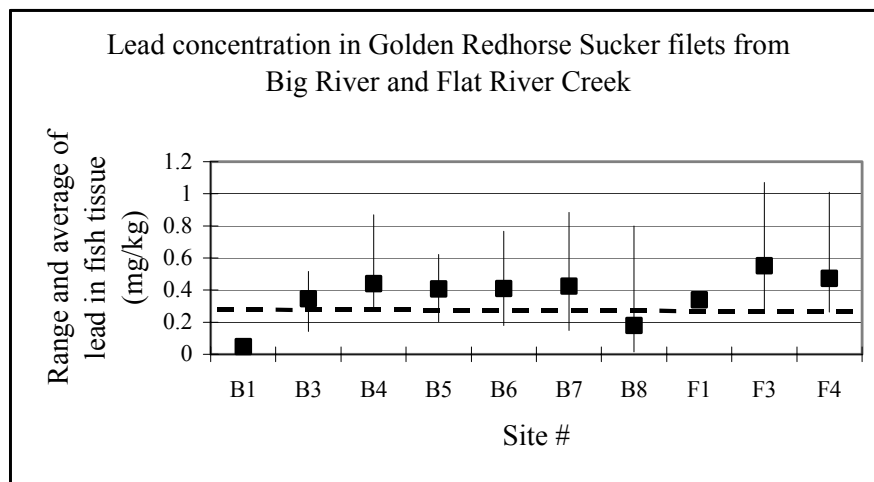
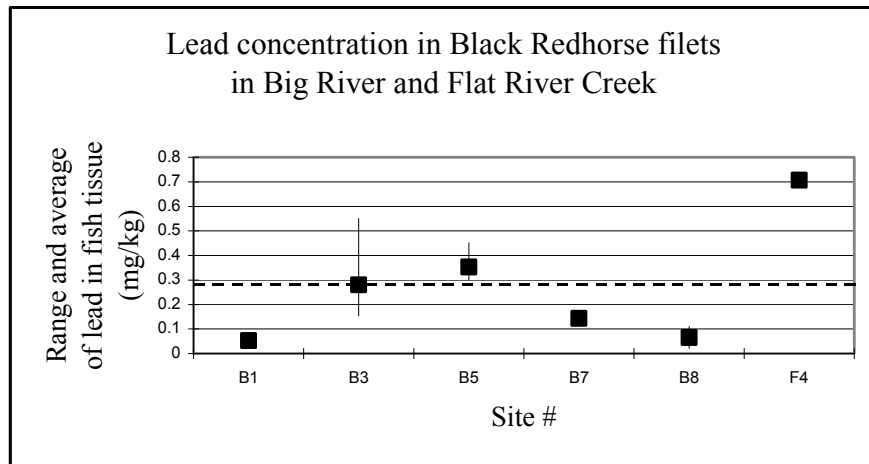
- F1 – Flat River Creek at Derby
- F2 – Flat River Creek just below Elvins tailing pile tributary
- F3 – Flat River Creek at Main Street, town of Flat River
- F4 – Flat River Creek below National chat pile

Detail of Flat River Creek on page 10.



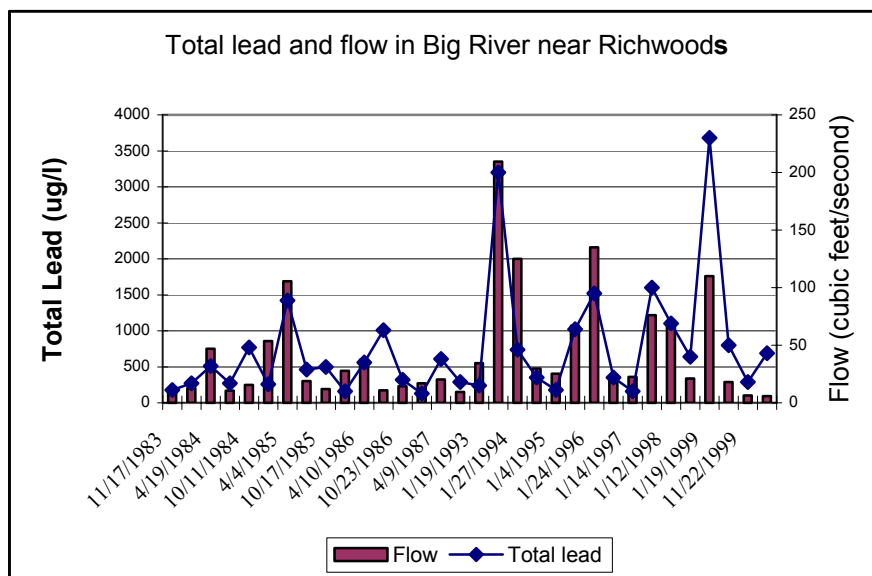
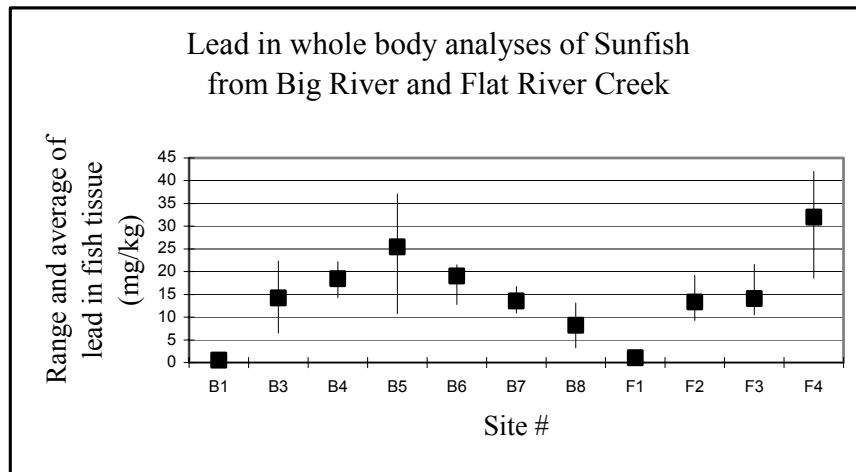
----- Dashed line equals 0.3 mg/kg, the maximum recommended lead concentration in fish to be consumed (World Health Organization).

Source: Dr. Gary Patterson, University of Missouri, Rolla



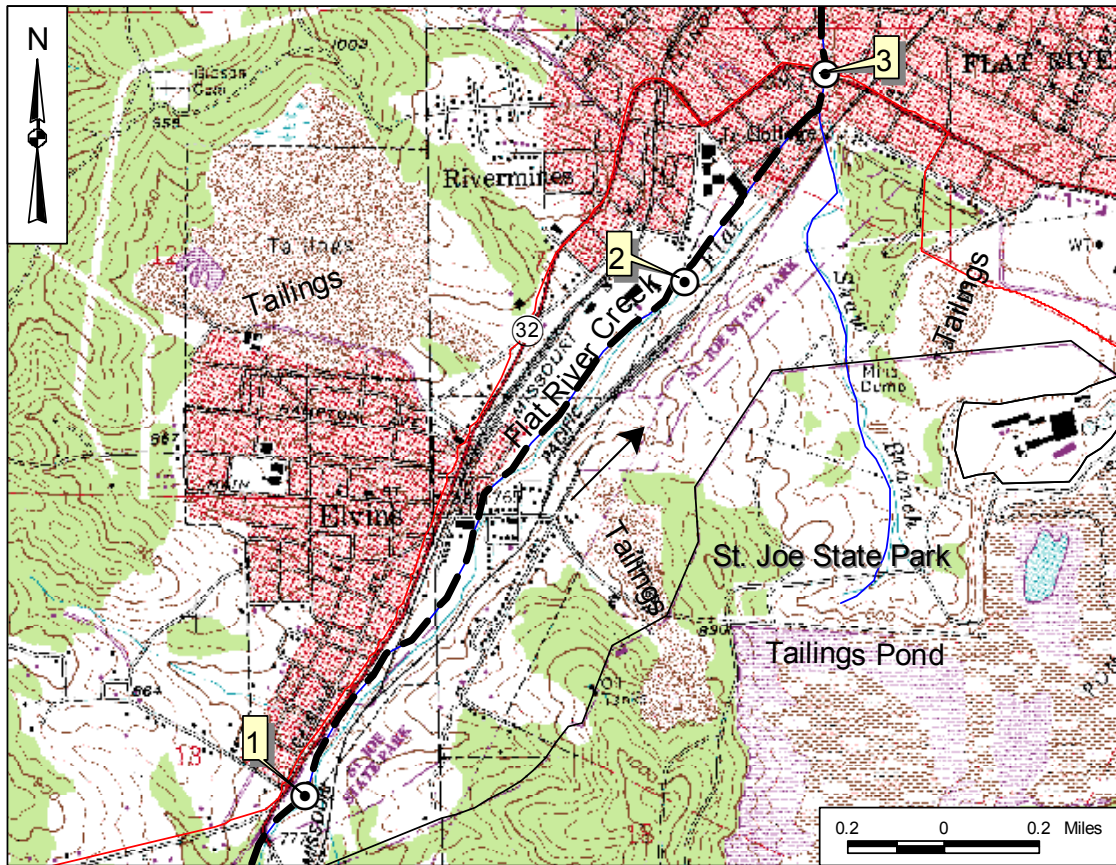
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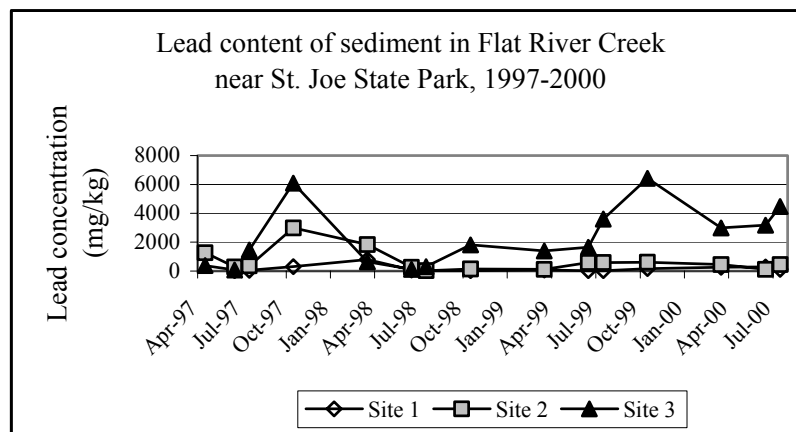
Detail of Flat River Creek

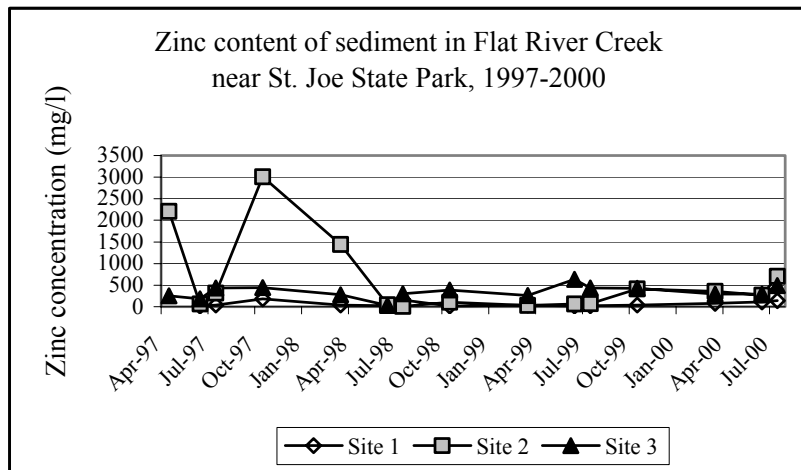


--- Impaired Segment → Direction of flow

Site Index

- 1 – Flat River Creek at Hwy B
- 2 – Flat River Creek at Rivermines
- 3 – Flat River Creek at Main Street, Flat River





Source: Missouri Department of Natural Resources, Division of State Parks

For more information call or write:

Missouri Department of Natural Resources

Water Protection Program

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